AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY 111:135–139 (2000)

Brief Communication: Bilateral Aplasia of the Condyles in a 1,400-Year-Old Mandible From Israel

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KEY WORDS hemifacial microsomia; mandibular condyle; aplasia; Neandertals; medial pterygoid tubercle

ABSTRACT A rare pathological mandible, manifesting bilateral absence of the condyles, is discussed. The pathology was identified as hemifacial microsomia. The mandible, dated to the Byzantine period in Israel, manifests bilateral aplasia of the condyles and extreme shortness, but normal width, of the body. The extremely well-developed coronoid process, the grooved masseter insertion area, and the manifestation of a medial pterygoid tubercle (MPT) suggest hypertrophy of the occlusal muscles. The presence of a large MPT is considered a Neandertal autapomorphy. Studying the biomechanic forces acting on the deformed mandible in hemifacial microsomia patients may shed light on the mastication process in Neandertals. Am J Phys Anthropol 111:135–139, 2000. © 2000 Wiley-Liss, Inc.

The agenesis (aplasia) or congenital absence of the mandibular condyle is an extremely rare pathological condition (Shafer et al., 1983). Its etiology is related to an inhibitory process occurring toward the seventh week of embryonic life, affecting bones derived from the first branchial arch (Gorlin et al., 1990; Ware, 1980). The pathology usually affects one of the sides to a larger extent: therefore, it is commonly termed "hemifacial microsomia" (Gorlin et al., 1990; Ware, 1980). Facial asymmetry and extreme retrusion of the mandible are characteristic of individuals with condylar aplasia or hypoplasia, resulting in malocclusion and esthetic problems.

Pathologies such as fractured, hypoplastic, or bifid mandibular condyles, although rare, have been reported in archaeological material (Alexandersen, 1967; Alexandersen et al., 1979; Stiebitz and Teschler-Nicola, 1981; Szentpétery et al., 1990; Vlcek and Ramba, 1991). This case of a 1,400-year-old mandible with bilateral aplasia of the condyles seems to be the first one reported in the paleopathologic literature.

MATERIALS AND METHODS

A complete mandible of an adult individual of unknown sex, manifesting absence of the mandibular condyles, was unearthed at the Byzantine site of Mamilla Cave, Jerusalem. A large assemblage of disarticulated fragmented human skeletal remains was uncovered in this cave. The skeletons represent the Christian population of Jerusalem, which was massacred by the Persians in 614 AD during their conquest of the city, as evidenced by historical records and archaeological findings (Milik, 1961; Nagar et al., 1999; Reich, 1994). The pathologic mandible was studied visually and metrically. A battery of eight conventional measurements of the mandible (following Buikstra and Ubelaker, 1994) and three specific measurements of the coronoid process were taken (Fig. 1). A sample of 15 nonpathological

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Received 4 January 1999; accepted 20 August 1999.

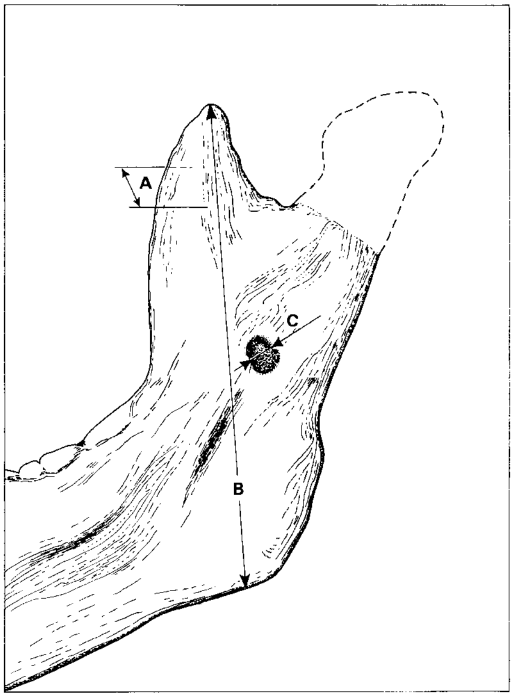

Fig. 1. Measurements of the coronoid process. A: Coronoid width at the level of the mandibular notch. B: Coronoid length from the base of the mandible to the tip of the process. C: Transverse diameter of the mandibular foramen.

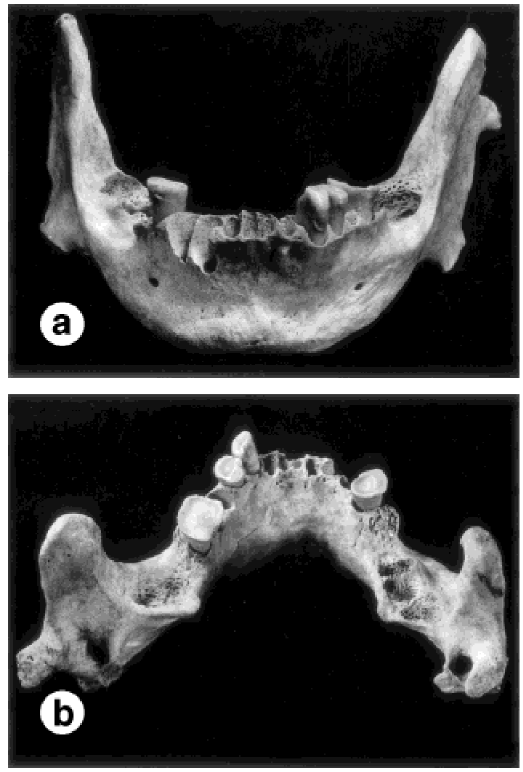

Fig. 2. The Mamilla pathological mandible. **a:** Anterior view. **b:** Superior view. Note the extreme shortness of the mandibular body and the large projection of the gonion.

mandibles from the same skeletal assemblage were studied for metrical comparison.

Description of pathology

Unlike most of the human remains in Mamilla Cave, the pathological mandible is intact. The mandible is extremely short and lacks true condyles (Fig. 2). However, the dental attrition pattern and extent indicate that the mandible was functional. A relatively old age of the individual is assumed, based on the attrition rate.

On both rami, the entire supero-posterior part is missing. At the inferior part of the mandibular notch, small bony projections are present (Fig. 3). The projection on the right side (5 × 8 mm) projects medially and exhibits a smooth posterior aspect. The projection on the left is larger (7 × 10 mm), projecting laterally and downward, and exhibits a rugged appearance, resembling a pseudoarticulation. The coronoid process is unusually wide, thick, and arch-shaped (Table 1). The mandibular foramina face posteriorly, surrounded by thick bony walls. They are rounded, conical in shape, and extremely large (10 mm in diameter, Table 1). Below the foramina, a series of transverse ridges is apparent. These markings of the medial pterygoid muscle start at the gonion and increase in size as they ascend the ramus. They terminate in a prominent tubercle at the upper part of the muscle attachment area, corresponding to the hypertrophy of the superiormost fibers (Fig. 4). The gonion area is square in shape, projecting downward to a considerable length, resulting in a strongly concave inferior border of the mandibular body (antegonial notch). The markings of the masseter insertion on the lateral aspect of the rami take the form of a shallow groove, ascending vertically from the gonion.

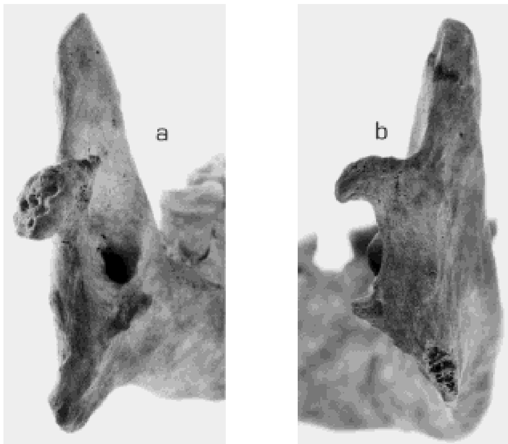

Fig. 3. Mamilla mandible, posterior border of the left (**a**) and right (**b**) rami.

The mandibular body is extremely short (Table 1); hence, the mandibular arch is wide. The body is very high at the symphysis and sharply declines towards the molar teeth. Metrical comparison between the pathological mandible and the nonpathological mandibles from the same site is presented in Table 1. The pathological mandible has normal width but abnormal length. The dimensions of the coronoid processes and the openings of the mandibular foramina are over three standard deviations larger than those in the reference population.

Only four teeth (right second premolar, left canine, left first premolar, and left first molar) are present. Increased distance between the cemento-enamel junction and the alveolar crest is observed. The posterior teeth exhibit advanced attrition (over half-crown worn), with excessive deposition of secondary dentine. The anterior teeth are much less worn. The right first molar and left second molar were lost antemortem. The second and third molars on both sides were probably tilted mesially, according to the orientation of the alveoli.

DISCUSSION

Etiology of the disease

A distinction between congenital and acquired forms of condylar absence was suggested (Rabey, 1997). In the acquired form, normal development of the condyles proceeds, until the lytic event occurs. The abnormal shortness of the Mamilla mandible, and the total absence of normal condylar development, favor the congenital distinction (hemifacial microsomia) of the disease (Gorlin et al., 1990; Rabey, 1997).

Functional implications

Regardless of its distorted morphology, dental attrition indicates occlusion. Two features should have prevented occlusion: 1) the extremely short mandibular body, and 2) smaller or absent condyles causing retrusion of the mandible (Klein and Howaldt, 1995; Ware, 1980). Occlusion was probably achieved due to two features: 1) shortness of the maxilla, and 2) displacement of the temporomandibular joint antero-inferiorly. Both features are characteristic of hemifacial microsomia (Gorlin et al., 1990).

When the teeth are in occlusion in humans missing their condyles, the condylar neck-stumps are opposite the articular eminence (Rabey, 1997). Dislocation of the joint anteroinferiorly is also present after condylar fractures (Raustia et al., 1990). In the present case, the rugged surface of the bony projection on the posterior border of the left ramus probably articulated with the articular eminence, anterior and inferior to the glenoid fossa of the temporomandibular joint. This rugged surface points to an alternative joint that was functional. On the right side, no articulation between the mandible and the skull probably existed.

In view of the joint disposition and the hypertrophy of the occlusal muscles, mastication was probably altered. The dental attrition pattern suggests overstress on the posterior teeth, less so (or even an open bite) on the incisors. This pattern is common when the vertical height of the mandibular ramus is reduced (Bell, 1979). As is evident from the extremely large opening of the mandibular foramen (Table 1), the axis of jaw rotation was changed, with the foramen no longer being the pivot point of mandibular movement.

Paleontological implications

The topography of the medial aspect of the Mamilla mandibular ramus, at the insertion

TABLE 1. Metric comparison between the pathological mandible and a sample of nonpathological mandibles from Mamilla

Measurement	Mamilla nonpathological mandibles			Pathological mandible measurement (mm)
	Observations	Mean (mm)	S.D.	
Body length	4	80.0	5.0	50
Symphysial height	7	33.3	3.1	34
Width at mental foramen	8	13.1	1.7	15
Ramus, minimum width	14	32.1	2.0	28
Mandibular angle	4	120.0	8.5	127
Bimental breadth	4	44.5	1.9	42
Bigonial breadth	2	99.5	2.1	101
Bicoronoid breadth	1	99.0		92
Coronoid height[1]	15	63.7	5.0	61
Coronoid width[1]	15	5.5	0.8	10
Diameter of the mandibular foramen[1]	14	5.1	0.8	10

[1] See Figure 1.

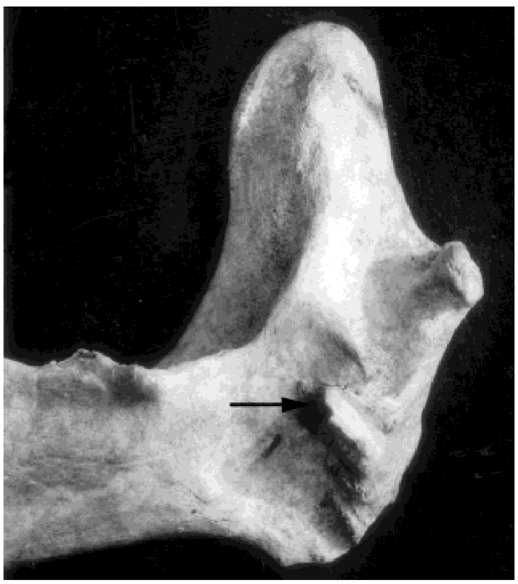

Fig. 4. Medial view of the Mamilla right mandibular ramus, showing the insertion area of the medial pterygoid muscle. Arrow indicates medial pterygoid tubercle.

area of the medial pterygoid muscle, resembles the gradually intensifying hypertrophy of this area described for the Kebara 2 Neandertal mandible (Tillier et al., 1989). Two anatomical features are recognizable in the Mamilla mandible: "scallop tubercles" (Anton, 1996) and "medial pterygoid tubercle" (Anton, 1996; Rak et al., 1994, 1996). The medial pterygoid tubercle (MPT) is considered by some authors an autapomorphy of Neandertal mandibles (Rak et al., 1994, 1996). Anton (1996) admits the larger manifestation of the MPT in Neandertals. These features in the Mamilla specimen are no less developed (Fig. 4).

A case of hemifacial microsomia with unilateral condylar hypoplasia was reported for a 9-year-old girl (Nakata et al., 1995). The investigators found greater medial pterygoid muscle activity on the affected side. Overdevelopment of this muscle as a biomechanical consequence of jaw deformity is possible. However, the Mamilla mandible and the young girl's mandible are largely different in the extent of the deformity, its laterality, and the age of the patients. Besides, these jaws are markedly short, while Anton (1996) suggests the larger MPT in Neandertals to be the result of masticatory forces of a prognathic hominid. Therefore, the biomechanical advantage of having this trait is not clear and should be a subject of further investigation.

CONCLUSIONS

The Mamilla mandible is the first case described of hemifacial microsomia in archaeologically derived skeletal material. The mandible's main characteristics are: bilateral aplasia of the condylar processes, short body, extremely developed coronoid processes, and powerful markings of the medial pterygoid and the masseter. Despite the abnormal morphology, the Mamilla pathological mandible was functioning. Occlusion was achieved by anteroinferior displacement of the temporomandibular joint (creation of an alternative articulation between

the left articular eminence and the ramus), and probably by a shortness of the maxilla.

Hypertrophy of the medial pterygoid muscle resulted in a medial pterygoid tubercle on the medial aspect of the ramus, resembling its manifestation in Neandertals. A biomechanical advantage of having this trait in the pathological mandible is possible. Having a morphological similarity, the insertion area of the medial pterygoid attachment and the medial pterygoid muscle activity in hemifacial microsomia patients may provide insight about the mastication process in *Homo neanderthalensis*.

ACKNOWLEDGMENTS

We thank Prof. Israel Hershkovitz for his helpful comments and ideas, Mrs. Tzila Sagiv for the photography, and Mrs. Anna Bachar for the illustrations.

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